Joint Precision Approach And Landing System (JPALS)

JPALS System Engineering Overview

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Outline

- SDD Responsibilities
- Incremental Approach
- Notional Architecture Definitions
- Integration Concepts
- Specifications and Standards
- Technical Challenges
- GPS Requirements
- UAV Requirements
- LAAS Interoperability
- Certification Requirements
- Feedback

SDD Contractor Deliverables

- Documentation (Design, Interfaces, SW etc)
- Land based JPALS tactical (T) and fixed (F) base systems
  - Test Van (T), Pax Landing Systems Test Facility (LSTF) (F), Holloman (T,F), Edwards (T,F)
- Sea based JPALS system
  - Test Van (1), LSTF (1), and shipboard sets (4)
- JPALS Avionics subsystems (6, production representative)

SDD Contractor Deliverables (2)

- JPALS simulations and models
  - Integration Models (ship and aircraft ICD's)
  - System Models (availability, to support certifications)
  - 6 Degree of Freedom Sea Based simulation models (for aircraft simulation)
  - Data Link models (system level)
- Support / Test Equipment
  - Data Link Stimulation/ Test
  - GPS Stimulation
  - Antenna Calibration
- Logistics Products including Training and Spares

SDD Integration and Support

- Contractor support for integration and installation of JPALS systems
  - Integration Labs
  - Landing System Test Facility (LSTF)
  - Test Aircraft
  - First ships
  - First Fixed Base installations
  - Tactical System initial set up and deployment
- Contractor Test support
  - Labs, Installed Test Facilities
  - Ground Tests
  - Navigation Avionics Platform Integration Emulator (NAPIE) (F/A-18, MH-60), JSF, C-12 testing ashore and at sea

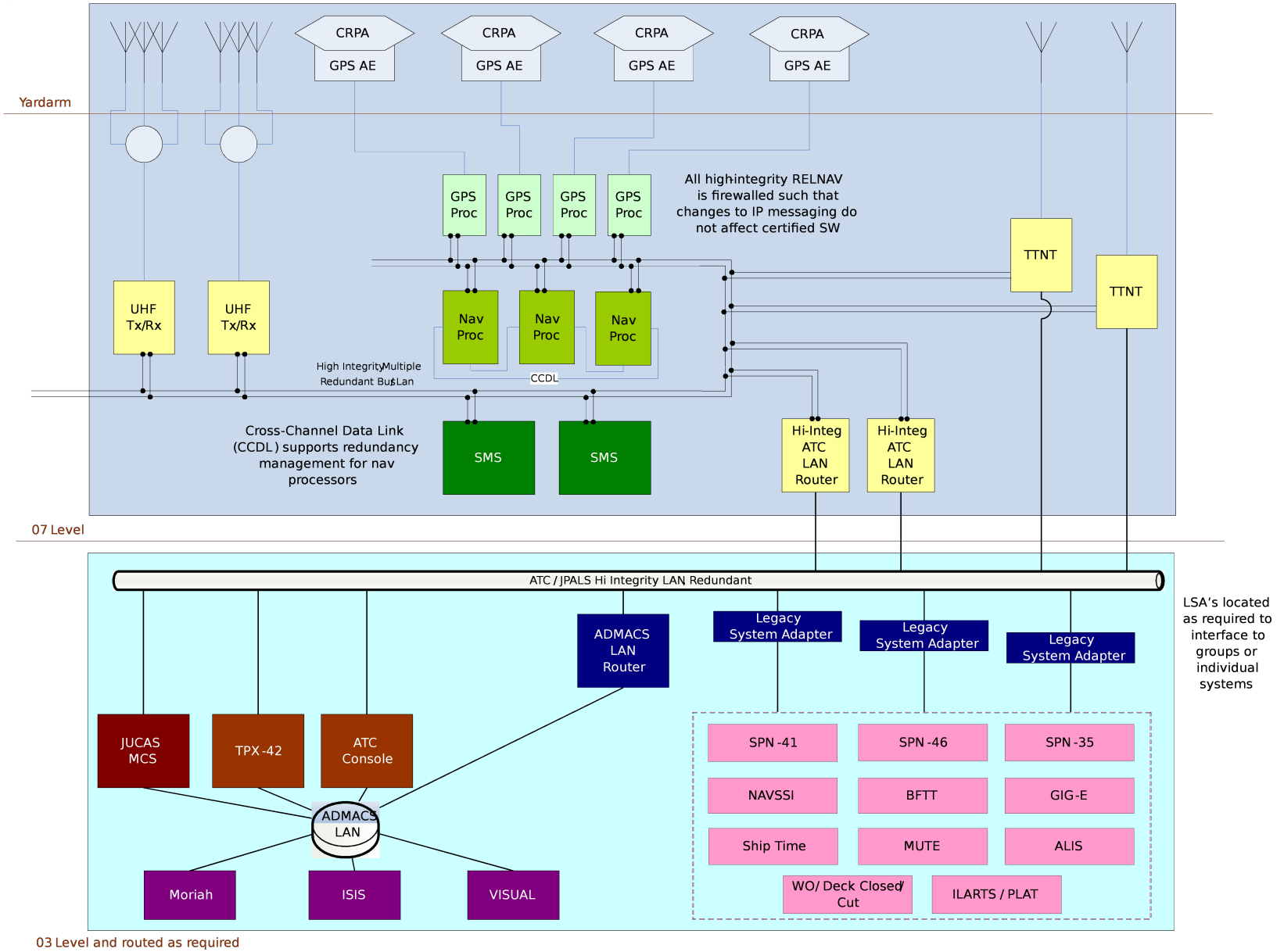
Government Contributions

- Performance requirements
- Candidate architecture, algorithms and design guidance
  - Output from TD phase efforts
- Test Sites, Facilities and Aircraft
  - Integration Labs
  - Jamming Ranges
  - Landing System Test Facility
  - Test Van
  - Test Aircraft
  - Ships

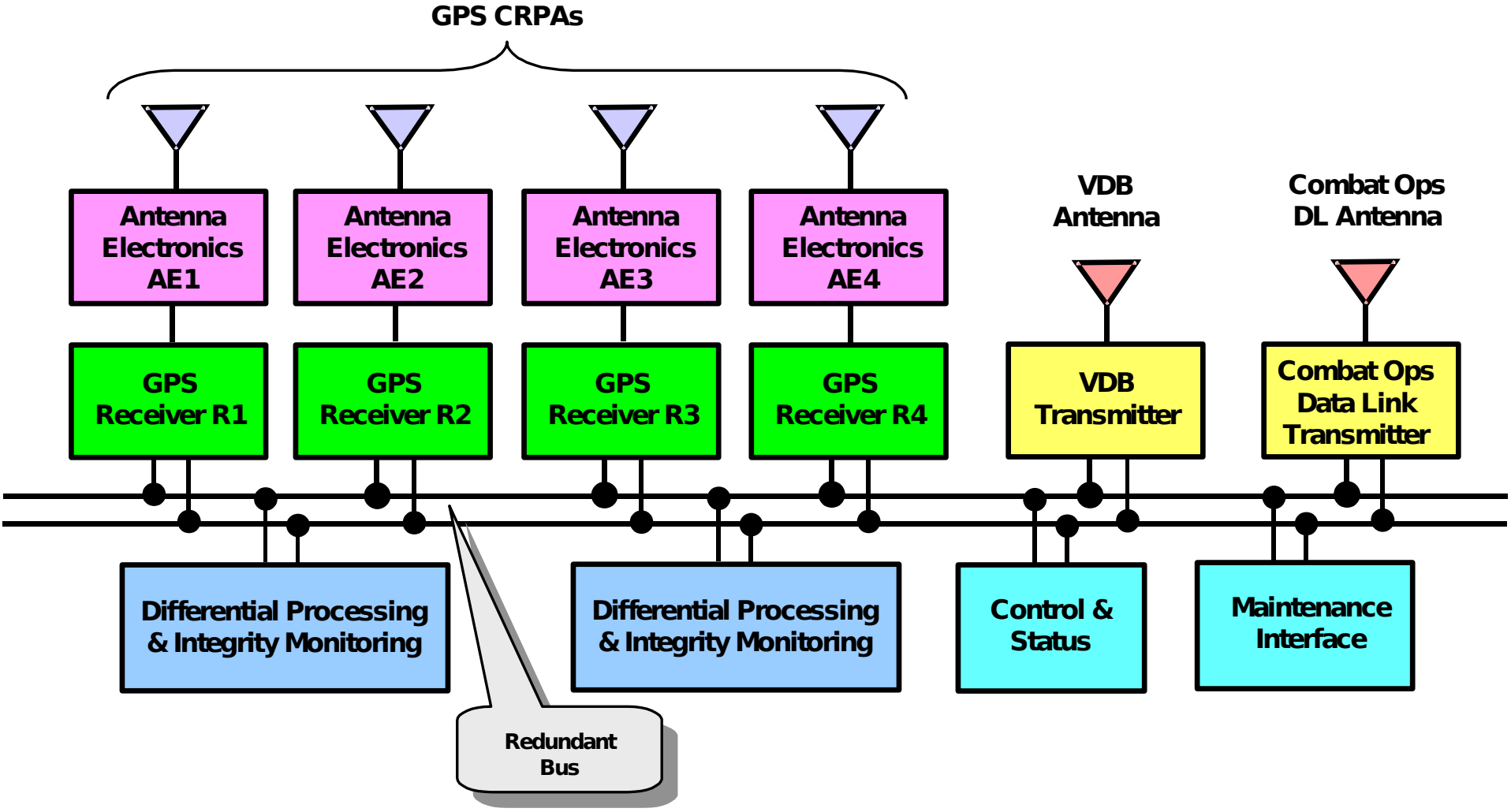
Planned Increments

- Increment 1
  - Land Based CAT I for Tactical and Fixed Base
  - Sea Based for CV and LHA/D supporting Autoland and 0/0
- Increment 2
  - Land Based CAT II for Tactical and Fixed Base
- Increment 3
  - Land Based Special Mission

Notional Shipboard Architecture

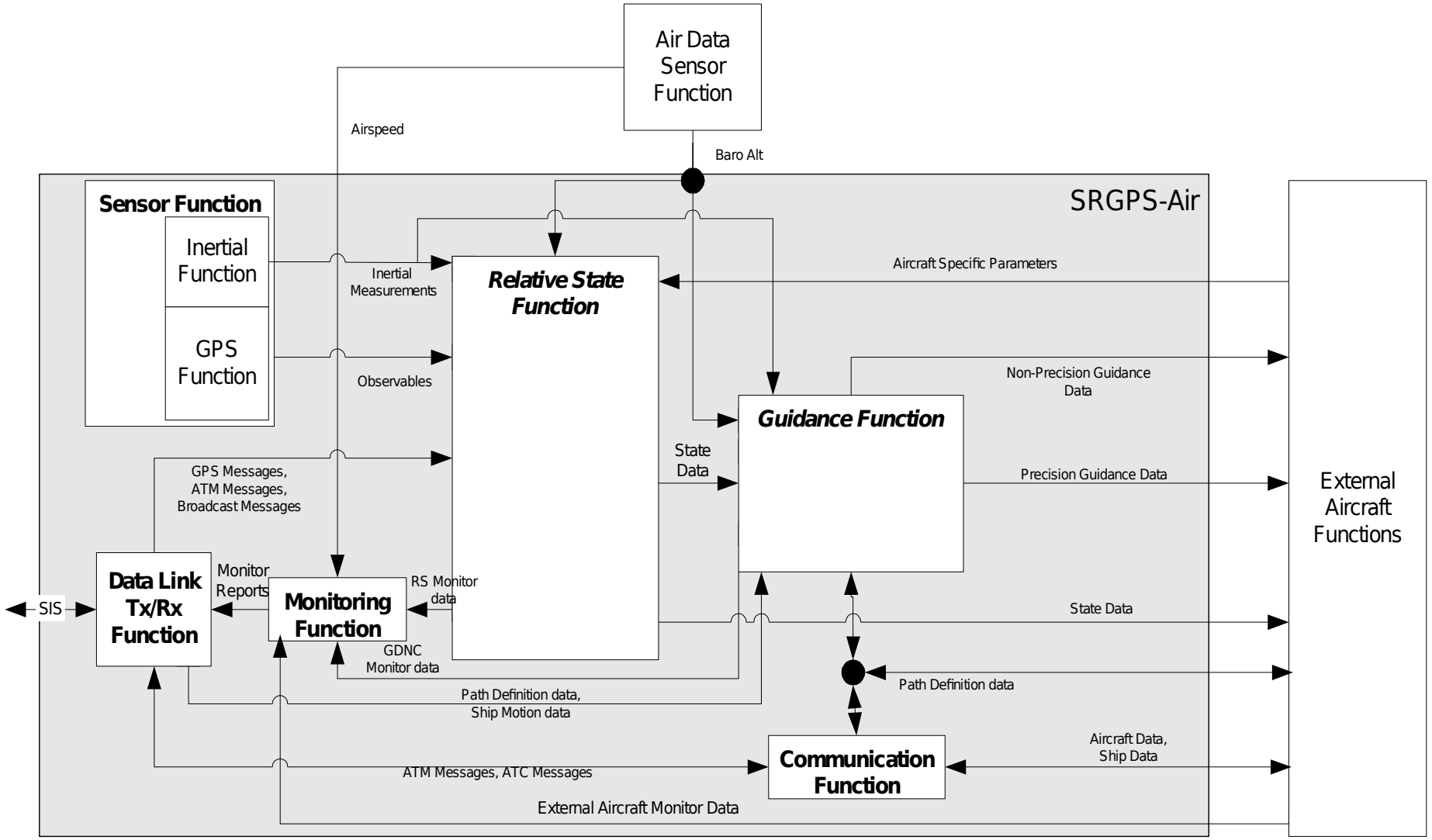


Notional Ground Architecture



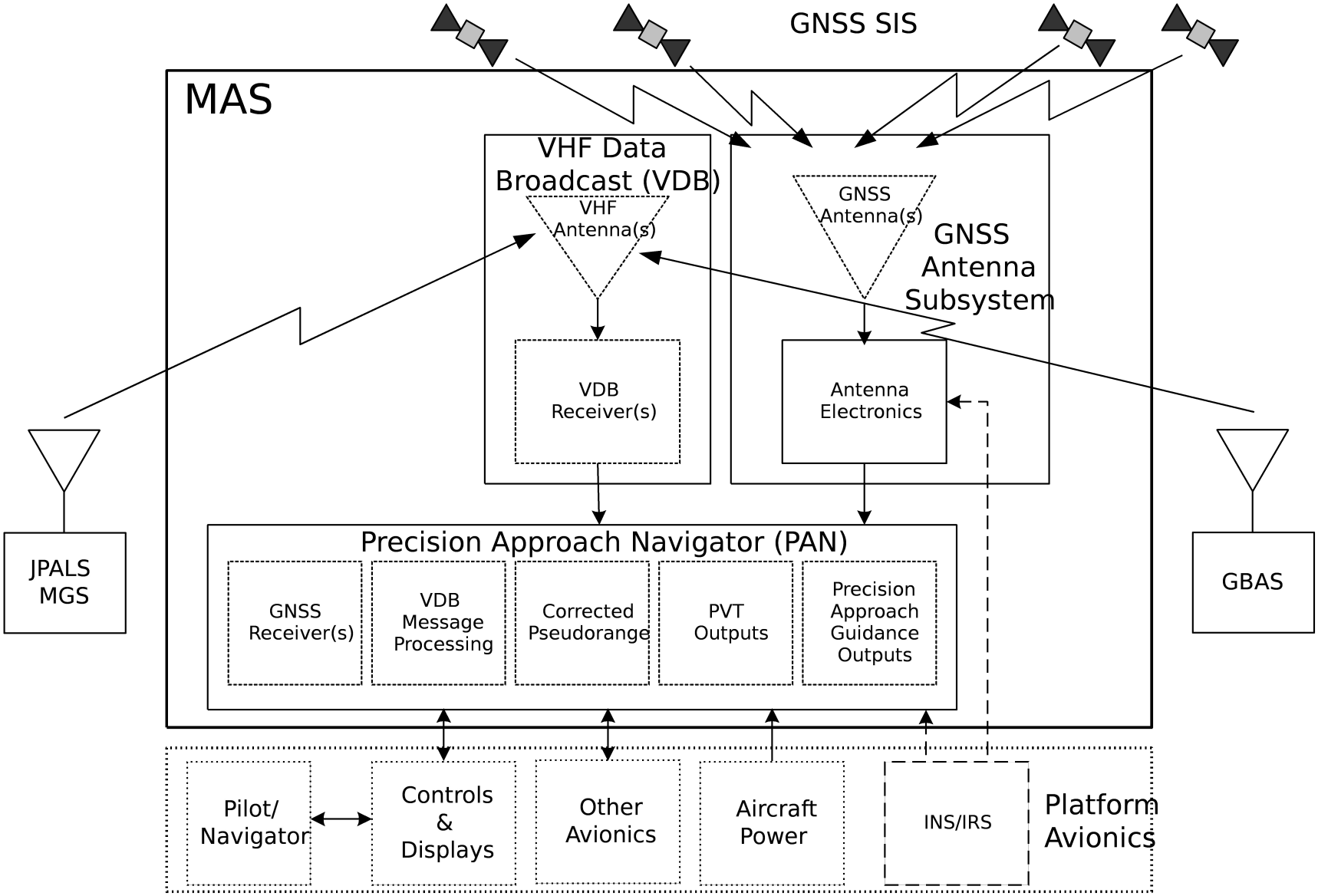
Notional Aircraft Architecture

Sea Based JPALS



Notional Aircraft Architecture

Land Based



Open System Architecture Approach

- The Joint Operational Architecture and the DoD Information Technology Standards Registry (DISR), the replacement for the DoD Joint Technical Architecture (JTA), serve as the foundation for evolutionary development of JPALS mission area integrated architectures
  - The DoD Technical Reference Model (TRM)
    - Common conceptual framework for acquisition, development, and support
    - Separation of data from applications and applications from the computing platform—a key principle in achieving open systems
- Commonality of Land Based Fixed, Tactical, and Sea Based architectures
  - Non-Developmental Items and/or Commercial Off the Shelf (COTS)

Software and Hardware Architectures

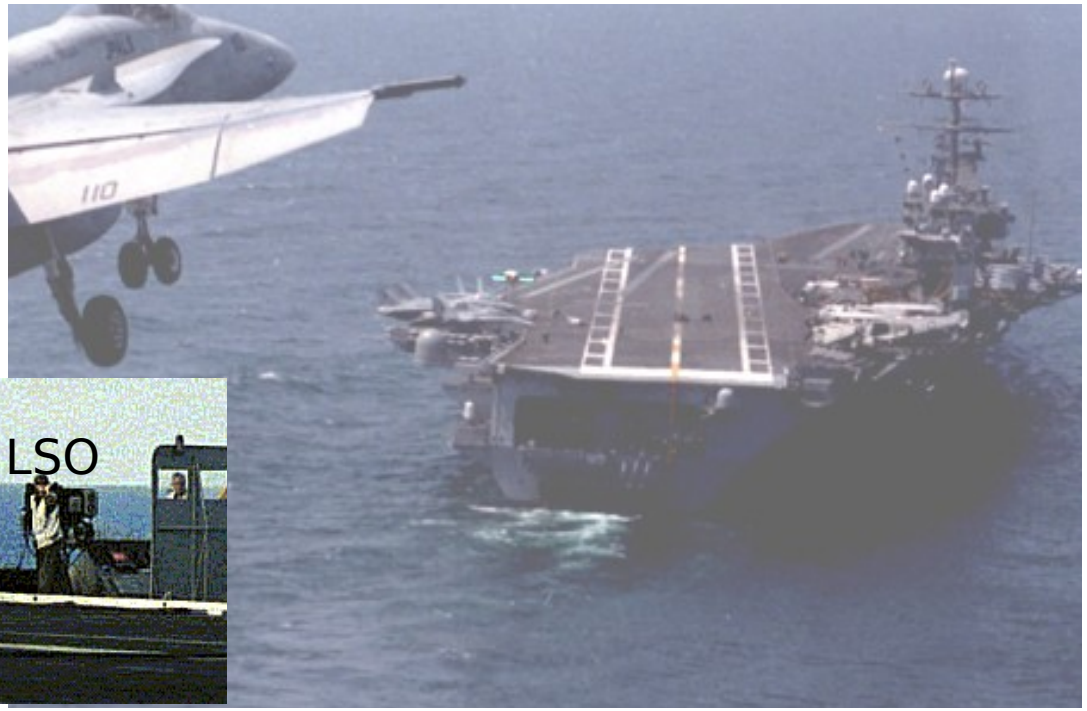
- Open Systems Architecture Design
  - Top down, modular, standards-based architecture in the design of systems.
  - Architectural based software systems that support open system concepts;
    - Exploit COTS computer systems products
    - National Security Telecommunications and Information Systems Security Policy (NSTISSP) Number 11 compliant
    - Allow incremental improvements based on modular, reusable, extensible software
- Defense Information Infrastructure (DII) Common Operating Environment (COE)
- Component-Based Software Engineering
  - Component Interfaces Specification
  - Software Component Development Method
- Aspect-oriented programming (AOP)
- Object-oriented programming (OOP)

Ship Integration Concept

JPALS integration in ships maximizes use of existing systems Including use of NAVSSI GPS antennas if possible

Install GPS & Data Link Antennas (Topside WG)

Interface JPALS information to ADMACS ISIS in Air Operations Work Centers



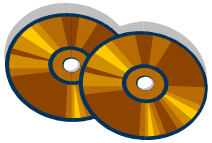
PriFly

LSO

Add JPALS fault tolerant processors (approx 2 half-height 19”

CATCC / AATCC

Interface software for ATC Systems



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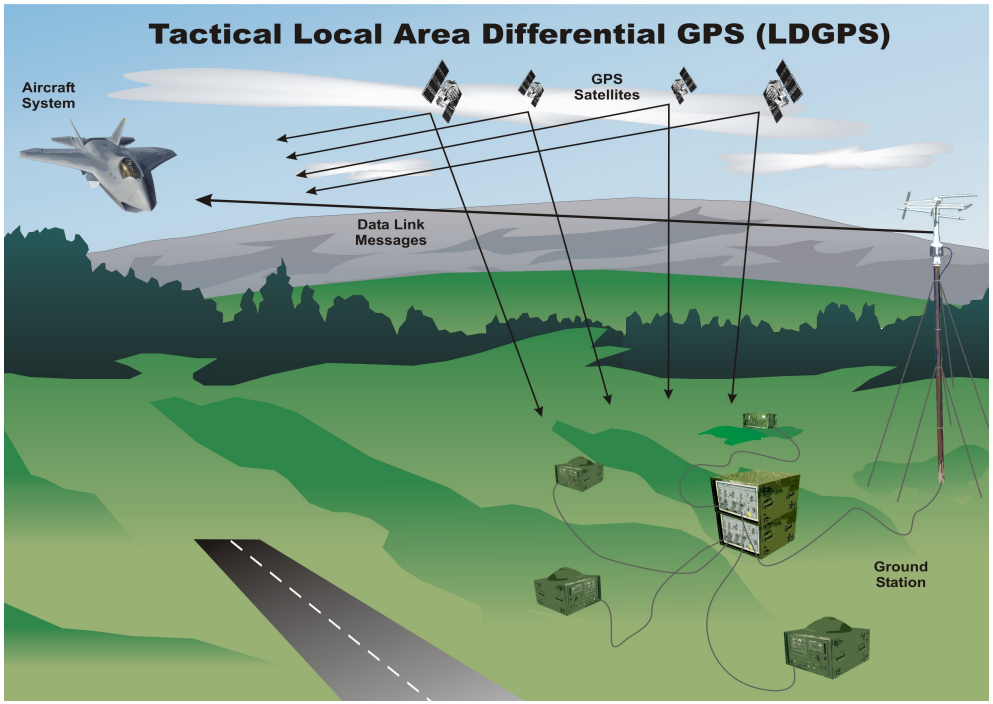
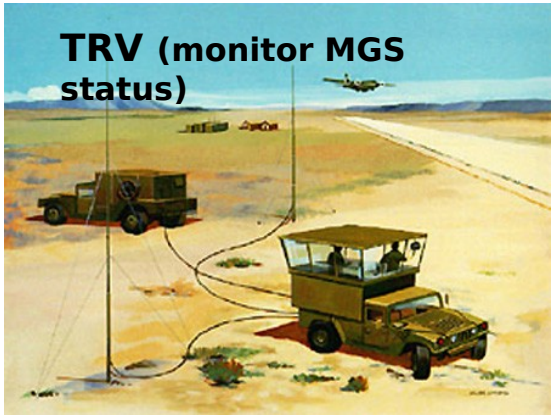
Ground Integration Concept



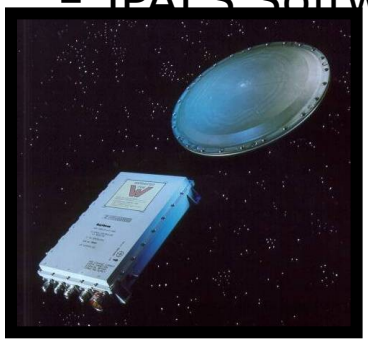
Land based JPALS will be integrated with existing airfield communication and navigation systems to provide a complete Air Traffic Control and Landing System (ATCALS) capability

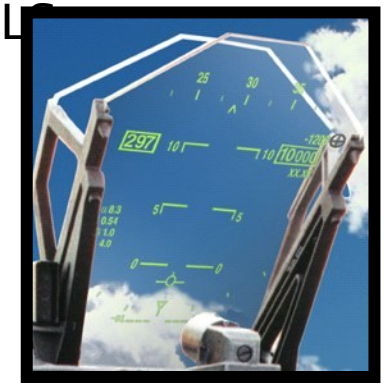


ASR and Operations Shelter (for separation and sequencing)

Aircraft Integration Concept

- JPALS integration in aircraft maximizes use of existing avionics modified as needed to provide required performance
  - No A-Kit changes
- Avionics components may include:
  - GPS Sensors – e.g., MAGR2K or EGI
  - AJ Antenna Systems - CRPA
  - Inertial Navigation Sensors – e.g., CAINS II or EGI
  - Computer Processing Equipment – e.g., existing MC or added processor in EGI
  - Data Link (Rx for Land Based and Rx/Tx for Sea Based JPALS) – e.g., ARC-210, RT1379 , MIDS, or included in MMR
  - JPALS Software Algorithms for Land and Sea Based JPALS

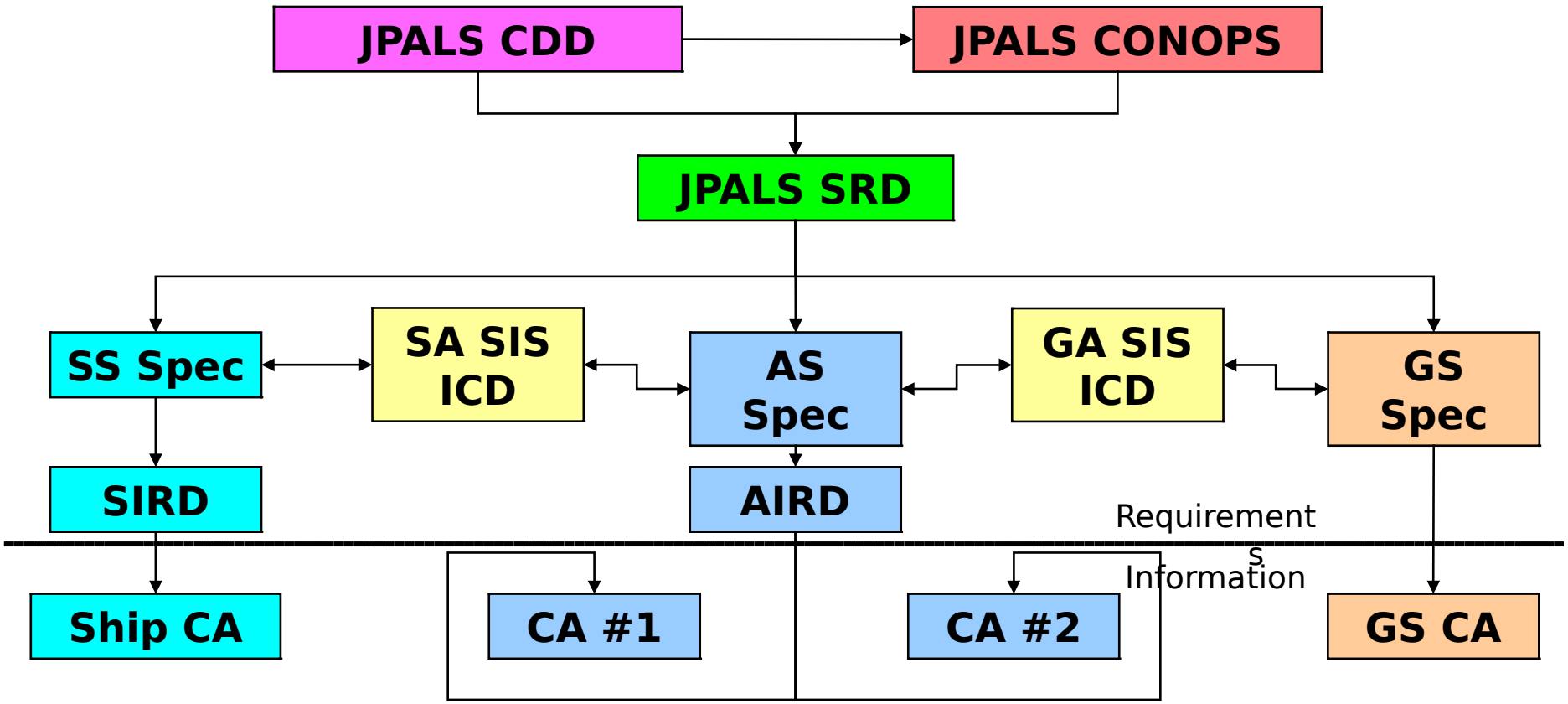




Specs and Standards

- NATO STANAG's
  - STANAG 4550 on Local Area Differential Global Positioning System for Military Precision Approach
  - STANAG 4565 on Airborne Multi-Mode Receiver for Precision Approach
  - STANAG 4392 - A Data Interchange Format For Navstar Global Positioning System (GPS)
- RTCA
  - DO-245, LAAS Minimum Aviation System Performance Standard (Info)
  - DO-246B, LAAS Signal in Space ICD (Superceded by Annex 10)
  - DO-253A, LAAS Airborne Equipment Minimum Operational Performance Standard
- ICAO
  - Annex 10, Standards and Recommended Practices (SARPS)
- Air Standardization Coordinating Committee of American-British-Canadian-Australian-New Zealand air forces
  - INFO PUB 70/20B Airborne GPS Equipment –
  - INFO PUB 70/28A Approach and Landing Systems

Proposed Document Tree



AS Airborne Segment
AIRD Aircraft Integration Requirements Doc
CA Candidate Architecture
CDD Capabilities Design Document
CONOPS Concept of Operations
GA Ground to Air
GS Ground Segment
ICD Interface Control Drawing
SA Ship to Air
SIRD Ship Integration Requirements Doc
SIS Signal in Space
SS Ship Segment
SRD Systems Requirements Document

Document Availability

- Public web site: http://pma213.navair.navy.mil/systems/jpals.htm
- CDD – JROC validation planned for October 2005
  - Draft ORD (approved by Services in 1998) is basis for current TD efforts
- CONOPS
  - Sea Based JPALS version in draft
    - Brief will be posted on the web site
    - Final can be released to contractors by request
  - Land Based JPALS version in work
- SRD –
  - Preliminary versions on web site
  - Will be combined into single SRD
  - Updates planned through September 2005
- Ship Segment Spec & Ground Segment Spec
  - Preliminary versions on web site
  - Updates planned through September 2005

Documentation Availabilty
(Continued)

- Airborne Segment Spec
  - Preliminary version for Sea Based JPALS on the web
  - Will be combined with Land Based JPALS
  - Updates planned through September 2005
- Signal in Space ICD's
  - Preliminary versions on web site
  - Updates planned through September 2005
- Integration Requirements Documents
  - Preliminary versions on web site by April 2005
  - Updates planned through September 2005
- Candidate Architectures
  - Under development during TD
  - Available on the web site by March 2005
  - Update planned before September 2005

Software Standards & Safety Requirements

- DoD standard data and follow data administrative policies in DoD Directive 8320.1 as applicable
- Systemic approach to supporting the Government's System Safety program (MIL-STD 882D)
- ISO/IEC 12207, IEEE/EIA 12207.0-2, and MIL-STD-498 software development documentation
- A software measurement process for planning and tracking the software program, and to assess and improve the software development process and the associated software product
  - Software Spiral Development.
  - Risk management process
  - Compliance with EVMS requirements
  - Implement configuration, change, and data management

Technical Challenges

- Data link
  - Must be compliant with JTRS, migration path TBD
  - TD to demonstrate UHF link in lab using modified ARC-210
  - L-Band may be path to full network and LPI capability
  - Combat Operations may require UHF link ashore
- GPS receiver
  - Candidate architectures based on 24 channel, dual frequency, SPS/PPS, code and carrier phase tracking, digital input, SAASM (M Code)
- GPS Performance in Jamming and Multipath
  - Initial testing indicates digital antenna electronics set with at least 16 beams on satellite and NavWar CRPA will be required
- Supportability concept for ground and ship segments
  - High reliability requirements
  - Extensive BIT
- Deployability - rapid siting, surveying and set-up

GPS Requirements

- SDD contractor will select and integrate GPS receiver, anti-jam system, and antenna for both the ship and ground stations as well as a prototype airborne system
  - Need to validate landing system performance in a jamming environment
    - Combination of M&S, lab and flight testing
    - Government will specify jamming environment and facilitate testing
- Several GPS anti-jam technology solutions have been and are being evaluated during TD
  - Government will provide results of TD anti-jam testing (with the exception of proprietary data) in parallel with the RFP release
- Aircraft Users anti-jam equipment will vary depending on the level of anti-jam protection needed to accomplish their mission
- The JPALS Program Office has and continues to work with the GPS JPO to influence and develop GPS Modernized UE and anti-jam requirements and systems to improve their support for JPALS

UAV Requirements

- J-UCAS
  - Requires Sea Based JPALS for operations on CV class ships
  - JPALS SDD systems support J-UCAS OA
    - Land Based OA ~ 2009
    - Carrier Based OA ~ 2011
- Retrofits
  - FireScout
    - Small ships
  - Global Hawk

LAAS Interoperability

- JPALS must be interoperable with ICAO Ground Based Augmentation Systems SARPS
- Sea Based and Land Based JPALS aircraft will have LAAS data link and navigation processing capability for landing at civil airfields (ref. RTCA DO-246B and DO-253A)
- Land Based JPALS ground stations will emulate LAAS for the recovery of suitably equipped Civil Reserve Air Fleet (CRAF) aircraft (ref. LAAS Cat I Spec., FAA-E-2937A)
- Land Based JPALS architecture is similar to LAAS
  - Driven by civil interoperability and similarity of operations
  - Main differences are the use of P(Y) code, the interference environment, the need for deployability, the potential use of dual frequency (enables more robust navigation processing) and the support of combat operations (information assurance)
- Preliminary interoperability capability demonstrated in

Certification Requirements

- Contractor's certification of at least SEI CMM Level III or equivalent
- Threat Validation and Intelligence Certification (DIA/J-2). (May be a check in the box as we do not tie up with Intel)
- Information Technology and National Security System Interoperability and Supportability Requirements Certification – (J-6)
- Clinger-Cohen Compliance Certification (DoN CIO)
  - Includes DoD Information Technology Security Certification and Accreditation (NAVAIR D/CIO DAA) (DoDI 5200.40)
- Spectrum Certification Compliance (DD Form 1494)
- Interoperability Certification (Joint Interoperability Test Command)
- Flight Deck Certification
- System Safety Certification
- JPALS System Certification (against the JPALS performance standard profile to be listed in the DISR-On-Line)
- Air Worthiness Certification
- OT approval for Service use
- Platform certification
- DoD Information Technology Security Certification and Accreditation Program (DITSCAP)

Want Feedback from Industry

- Feedback Areas
  - SDD responsibilities
  - Achievable architecture
  - Schedule
  - Technical Risks
  - Other?